

# Effects of Organic Carbon Distribution on Redox Chemistry in a Glacial Aquifer, Woodbury, Connecticut

Craig J. Brown<sup>1</sup>, Peter McMahon<sup>2</sup>, and J. Jeffrey Starn<sup>1</sup>

<sup>1</sup> U.S. Geological Survey, 101 Pitkin Street, East Hartford, CT 06108

<sup>2</sup> U.S. Geological Survey, Denver Federal Center, Bldg. 53, Lakewood, CO 80225

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## Biographical Sketches of Authors

Craig Brown is a hydrologist with the U.S. Geological Survey. His research interests include aquifer geochemistry, geochemical modeling, and processes associated with the transport of natural contaminants and other trace elements.

Pete McMahon is a hydrologist with the U.S. Geological Survey. His research interests include the geochemistry of aquifer systems, temporal variability in ground-water recharge chemistry, and application of isotope techniques in hydrologic studies.

Jeff Starn has been a hydrologist with the Federal government for over twenty years. He has worked overseas with the Peace Corps, with the USEPA in Region IV, and with the USGS in the Kentucky and Connecticut Water Science Centers. His current interests include probabilistic ground-water modeling and using combined watershed and ground-water models to help better understand hydrologic processes in glacial/crystalline rock aquifer systems.

## Abstract

Glacial aquifers in much of the northeastern United States consist of stratified glacial valley-fill deposits of limited lateral extent. Ground water in these aquifers is typically young (< 10 years old), and rates of flow are typically high (hydraulic conductivity values range from 1.5 meters per day in tills to 46 meters per day in sand and gravels). Consequently, redox conditions are generally considered to be oxic throughout the aquifer. In reality, localized reducing conditions can result from dissolved organic carbon (DOC) that is leached from natural organic matter or from anthropogenic sources. A study of groundwater flow and geochemistry in the contributing area to a community supply well in Woodbury, Connecticut, identified organic carbon sources that include: (1) DOC leached from surface water in the summer and fall months, (2) natural sedimentary organic matter (>1 percent) in some sediments, and (3) contaminant point sources (septic leach fields, leaking storage tanks, or spills). The leaching of DOC from these sources can result in localized reducing zones that affect the movement of contaminants for tens to hundreds of feet downgradient. Older ground water derived from adjacent or underlying till and fractured bedrock also tends to have reducing redox chemistry that may or may not be affected by organic carbon.

High concentrations of DOC generally are associated with low concentrations of oxygen and nitrate, and high concentrations of dissolved manganese, iron, and sulfide. Naturally occurring trace elements, including arsenic, in sediments and rocks can be mobilized by reductive dissolution coupled to oxidation of organic carbon. Locally high concentrations of nitrate (from 3 mg/L to 19 mg/L as N) and DOC (from 0.5 to 89 mg/L) were observed in wells downgradient of several septic leachfields. Transport of nitrate leached from septic leach fields is limited by denitrification coupled to oxidation of organic carbon; nitrate in at least one sample near a leach field was enriched in <sup>15</sup>N, apparently as a result of biological fractionation. This effect of organic

carbon on ground-water redox chemistry generally is spatially limited in these glacial aquifers, but can be important on a local scale.